

to be composed of spores, parts of animalculæ, and even living infusoriæ. Amongst the metallic salts we must mention particles of meteoric iron, evidently of cosmic origin. It is contemplated by the city of Paris to establish similar observations in several parts of the city, and the careful comparison of these analyses will prove invaluable for establishing a number of most interesting facts having a bearing on the welfare of inhabitants, as well as on the elucidation of important scientific problems.

It is also contemplated to make use of æronautical ascents to test the air at any altitude accessible to a balloon with horizontal glass plates covered with glycerine. The moisture of the clouds is to be condensed on glass tubes which will be refrigerated.

The ozone testing and measuring has produced also startling facts. Although the quantity of ozone is very minute, amounting to only a few milligrams per 1,000 cubic metres, it has been proved that on Feb. 27, the day of the ozone maximum, a quantity of 900 kilog. was floating over Paris, if we suppose that the quantity was the same as at Montsouris in the whole stream of air passing above up to the altitude of 1,000 metres.

These results are only a sample of those which may be expected from the constant application of the magnificent system which is now brought into operation for the first time, and of which it will be possible to say, *Virco acquirit eundo*.
W. DE FONVIELLE

NOTES

THE following are the arrangements for the Free Lectures in connection with the Loan Collection of Scientific Apparatus for the next few weeks. The lecture hour is eight P.M. Saturday, June 17, Mr. W. H. Preece on Telegraphic Instruments; Monday, June 19, Mr. Kempe on the Application of Linkages to Machinery; Saturday, June 24, Capt. Abney, F.R.S., on Photographic Printing Processes; Monday, June 26, Dr. Schuster on Ampère's and Faraday's Instruments; Saturday, July 1, Mr. W. C. Roberts, F.R.S., Graham's Apparatus and what he did with it; Monday, July 3, The Right Hon. Dr. Lyon Playfair, C.B., F.R.S., Otto von Guericke's and Black's Instruments; Saturday, July 8, Dr. Gladstone on the Instruments lent by the Royal Institution.

On the 1st inst. the Society of Arts of Geneva celebrated the first centenary of its existence. Founded in 1776 by H. B. De Saussure and some of his friends, it has continued ever since to render real service to Switzerland in the departments of Arts, Industry, Commerce, and Agriculture. Without having any direct connection with science, it has always, however, been associated with it, and all the scientific men of Geneva have from time to time taken a share in its proceedings; the Pictets, De Candolles, De la Rives, and other well-known names, have at various times been presidents. A prize founded by Aug. De la Rive, to be awarded to the discovery most useful to Genevese industry, is intrusted to the care of the Society. In order worthily to celebrate the centenary, the Society had announced various competitions in the different branches with which it is connected, and which appealed to all manufacturers of horological instruments. The nature and terms of this competition we announced last October (vol. xii., p. 525). It was an international competition in chronometry, in which there was a large number of competitors, and of which the results have been now made known. A Prize of Honour was awarded to M. Ulysse Nardin, of Locle, Neuchâtel; six equal First Prizes were awarded to M. H. R. Ekegrin, of Geneva, Messrs. Parkinson and Frodsham, of London, Messrs. Badollet and Co., Geneva, Predard et Fils, Geneva, M. Ed. Perregaux, of Locle, and M. Fritz Piguet, of Geneva; other awards were likewise made. After the general meeting and the distribution of prizes, a banquet was held, at which about four hundred members of the

Society were present; this was followed by a conversazione on the terrace of M. Th. De Saussure, grandson of the celebrated naturalist, the founder of the Society, on the very place where the first meeting was held a century ago.

At the meeting of the Royal Geographical Society on Monday, Sir Rutherford Alcock, the new president, in the chair, a paper by Mr. E. D. Young, R.N., was read, on a journey to the northern end of Lake Nyassa. The cruise round Lake Nyassa had occupied a month, and the area was much larger than Dr. Livingstone thought, the north end extending to 9°20 S. lat. In most parts it was very deep, and in several places no bottom could be found with 100 fathoms of line. A range of mountains nearly 100 miles in length, extended above the lake, some reaching an elevation of 10,000 or 12,000 feet. There were also numerous rivers running into the lake, but none navigable for any distance. At some parts there were numbers of villages built on piles in the lake; many people in other parts living on barren rocks. Mr. Young added that he intended to be back to England in a few months, and would in the meanwhile make a more perfect survey of the lake and give the results to the Geographical Society on his return. A paper on "The Valley of the Tibagy, in Brazil," by Mr. T. B. Wither, C.E., was also read. The author of the paper was engaged in conjunction with others, in August, 1871, in exploring that section of the Ivahy Valley which lies between Colonia Theresa and the Corredeira de Ferro, or "Iron Rapid."

THE University of Oxford proposes to confer the degree of D.C.L. upon the following, among others:—Prof. W. H. Miller, F.R.S., Prof. J. Clerk Maxwell, F.R.S., Dr. Samuel Birch, and Lieut. V. L. Cameron.

THE Oxford University Bill was read a second time in the House of Commons on Monday. In the debate which followed there was nothing worthy of comment.

THE annual conversazione of the Society of Arts will be held at South Kensington Museum on Friday, the 23rd inst.

IN a recent issue of the Italian medical journal *L'Imparziale* laments that the unjust and ridiculous accusations of a number of strangers resident in Florence and of an exceedingly small minority of the inhabitants should have induced Prof. Schiff to accept the chair which has been offered to him at Geneva. The loss to physiology in Italy will be so great that, according to a communication in the *Daily News*, the *Bersagliere* believes that the Minister of Public Instruction will use every endeavour to make the illustrious physiologist withdraw his resignation.

EXCELLENT accounts have been received from the German North Asiatic Expedition, which has arrived as far as Semipalatinsk, in Siberia, and has obtained living specimens of the large Argali sheep (*Ovis ammon*) of Linneus.

THE veteran ornithologist, Dr. Hartlaub, has in preparation a new work upon the Ornithology of Madagascar and the adjacent islands. Since Dr. Hartlaub's original memoir on this subject was published in 1861, since which time Pollen, Van Dan, Crossley, Grandidier, and others, have done much to increase our knowledge of the avifauna of Madagascar.

WE hear from Sidney that the sum of 800*l.* had been raised towards Signor D'Albertis' expedition up the Fly River, New Guinea; and that he was intending to start from that city on the 19th of April with the steam-launch loaned to him by the Government of New South Wales.

WE regret to hear that the strife at Sidney about the dismissal of Mr. Krefft from the post of Curator and Secretary of the Australian Museum is not over. The subject came before the Legislative Assembly on the 6th of April, and provoked an

angry discussion. Mr. E. P. Ramsay has been installed by the trustees as Mr. Krefft's successor, and is in full work; but the Supreme Court has decided that the trustees had no real authority to remove Mr. Krefft. Whatever the issue may be, everyone acquainted with the case must hold that Mr. Krefft deserves fair and liberal treatment as one of the few naturalists in Australia that have done good original work in spite of many surrounding difficulties.

On June 7 a violent thunderstorm occurred at Valbonne, a large plain at a little distance from Lyons. The only objects struck were huts full of soldiers and arms, and the occurrence furnishes a good instance of the "power of points" and the attracting power of metals and living beings for lightning. Three tents were struck in succession. The occupant of the first was absent at the moment, and the effects were relatively slight, producing only the breaking of stones and dispersing of dust. In the second instance a soldier who was standing erect in front of one of the tents was struck; but the tent being located in the vicinity of an electric telegraph the lightning escaped by it, fired the wires, and broke a dozen poles. This may suggest a very easy method for protecting an encampment. The third flash struck a number of tents placed in a zig-zag line, doing much damage, several of the occupants being either killed or wounded. In one tent three men were killed and seven wounded. All of them were either touched in both legs or on the right side except one, who was wounded in the right eye. In another tent four men were wounded, all of them in both legs or in the left one. In other instances men were turned round in or heaved out of their beds. In all the instances referred to the men were lying on their beds, made of iron, and the sentry standing in front remained unhurt. In one tent a man, who was lying between two men who were killed, escaped unhurt. The uniforms of the soldiers were perforated and exhibited small spots; one, four centimetres in diameter, entirely sulphurised. A chemical analysis will be made of this part of the uniform, and the result communicated to the Academy of Sciences.

At a meeting of the Cymmrodorion Society held last Friday, in the Memorial Hall, Farringdon Street, Prof. F. W. Rudler, F.G.S., read a paper on "Natural History Museums, with Suggestions for the Formation of a Central Museum in Wales."

THE boring of the shafts for the Anglo-French tunnel is progressing favourably. A pump has been erected for the draining of the works. Water has been already met with in abundance, although the depth reached is only 40 feet. The intended level is 60 feet further down.

THE Edinburgh Town Council, it is stated, have agreed to apply to the Government for aid to the building fund of the University extension scheme, and to memorialise in favour of a parliamentary grant. The Council had previously subscribed 1,000 guineas to the fund on their own account.

THE Geographical Society of Paris has received good news from the Gaboon expedition. Lieut. Brazza and M. Marche have located themselves at Okanda, 500 miles from the mouth of the Ogowe, and are establishing permanent settlements and ready means of communicating with the factories on the coast. They lost a part of their baggage and goods in crossing rapids, but having been enabled to send messengers to the French Gaboon settlement they will recover from their losses and will proceed further in the untrodden region.

ON June 8 the French Society of Amis des Sciences held its annual meeting at Paris. M. Bert gave a lecture on the *Zenith* balloon catastrophe in connection with the inhalation of oxygen. This Society was founded by the Baron Thenard for assisting scientific men in their work and their families after their death.

THE French Society for Encouragement of National Industry had to vote this year the great Prony prize for the most useful invention in mechanics discovered during a certain number of years. The award was made to M. Henry Giffard, of Paris, the aéronaut, for the invention of his injector, used in all locomotives. The invention is fifteen years old, and the patentee has realised through this his single invention a fortune falling very little short of half a million sterling.

We take the following from the *Geographical Magazine*:—Dr. P. Ascherson left Benisuef for Medinet-el-Fayum, on March 16, and started from the latter place on the 24th, *en route* for the Little Oasis, the botanical exploration of which constituted the object of his journey. On April 1 he reached Bawiti, the present capital of the Oasis parva, by the same route as that followed by Belzoni in 1816. This journey proved that no "Bahr bela ma" or old river-bed exists in that portion of the Libyan Desert. After an exhaustive exploration of the oasis, Dr. Ascherson started on May 1 on his return journey, travelling by an entirely new route, and reaching the Nile at Samalut. The botanical exploration of the oases of the Libyan Desert begun two years ago by Dr. Ascherson, whilst a member of Rohlf's expedition, has thus been terminated, and several facts of great interest have been ascertained during this last journey as regards the Fayum, as well as the Little Oasis. Several species of plants, met with far to the east and south-west, in Asia, but not in the Valley of the Nile, or in the deserts to the east of it, occur also in the oases. Some of the more remarkable of these plants are *Dianthus Cyri*, *Populus euphratica* (= *P. diversifolia* of Mongolia), and *Prosopis Stephaniana*.

THE Society of Ethnology of Paris has proposed, for 1876, a prize to the best memoir on "The Slavonic Race, and Maps of the Countries inhabited by Slavonians." The prize will be awarded in December, and the memoir may be written in English as well as in French and in several other languages, not excluding Polish and Russian.

THE twenty-fifth Annual Educational Conference of the Society of Arts will take place on June 23, at 11 o'clock. The chair will be taken by Sir Henry Cole, K.C.B. With the view of giving special interest to the Conference this year, the Council have decided that the subject of adult education, especially in reference to technical instruction and its promotion by the action of the Government, shall form the principal subject for discussion.

PROF. E. QUETELET has written a brief notice in the *Bulletin* of the Royal Academy of Belgium, of the storm of March 12, 1876, which was the most violent hitherto observed at Brussels, the wind having reached the enormous pressure of 144 kilogrammes per square metre, or nearly 30 lbs. per square foot, and the barometer fallen to 28.560 inches at sea-level, having only once fallen below this point since the founding of the Observatory in 1833. We are glad to see that Dr. Buys Ballot is also examining this remarkable storm, which he will be able to do very fully owing to the number of registering barometers in operation at the Dutch Meteorological Stations.

In the *Supplemento alla Meteorologia Italiana*, anno 1875, fasc. ii., there appears a very valuable paper, by P. F. Denza, on the distribution of the rainfall in Italy during 1872. The paper, which is one of great ability, details the rainfall of that year, comparing it where possible with the averages of past years; and in consideration of the singular diversity with season of the rainfall of the different parts of Italy, the stations are classed according to five zones, viz., Alpine, Pre-alpine, East Apennine, West Apennine, and Sicilian. The details of the great rains of October 1872 are very interesting, the amount for the month being 40 inches at Pallanza, 41 inches at Crabbia,

49 inches at Scopello, and 69 inches at Oropa. The two absolutely largest daily falls occurred on the 5th, viz., 8.9 inches at Crabbia, and 9.1 inches at Mesma. Part iv. of the paper deals with the general causes determining the rainfall of Italy and the application of the results in explanation of the mode of the peculiar distribution of the rainfall over Italy during 1872.

MACMILLAN AND CO. will shortly publish the second part of Mr. Pickering's "Physical Manipulation."

THE annual meeting of the Aëronautical Society was held on the 7th inst., Mr. Charles Brook, F.R.S., presided. A paper was read by Mr. D. S. Brown on the advantage of applying power for aerial propulsion in an intermittent manner, and on the soaring of birds. Another paper by Mr. Armour, C.E., on air compression under wing-planes, was read.

THE fiftieth anniversary of the Société Industrielle de Mulhouse has been celebrated by an Exhibition of the Arts and Manufactures of Alsace. M. Perrot, one of the original founders, read the report, which showed that the Society has had a prosperous and useful career. Papers were read on the electric light, illustrated by the illumination of the banquet hall by electricity; on steam-engines; on borings at a great depth executed in Alsace; on electro-chemical experiments made on benzol. The meeting was a most successful one.

THE following additions have been made to the Royal Westminster Aquarium during the past week:—Young Green Turtle (*Chelonia viridis*) from the Island of Ascension, presented by officers of the *Challenger* expedition; Monk-fish (*Rhina squatina*); Blue and Red Wrasse (*Labrus mixtus*); Greater Weever (*Trachinus draco*); Horse Mackerel (*Trachurus trachurus*); Angler-fish (*Lophius piscatorius*); Gattoruginous Blenny (*Blennius gattorugineus*); Red Gurnard (*Trigla lyra*); Grey Gurnard (*T. gurnardus*); Streaked Gurnard (*T. lineata*); Lump-fish (*Cyclopterus lumpus*); Sea Lamprey (*Petromyzon marinus*); Mud Lamprey (*Ammocoetes branchialis*).

THE additions to the Zoological Society's Gardens during the past week include among others, a Mexican Deer (*Cervus mexicanus*) from S. America, presented by Mr. Thos. B. Forwood; two Spur-winged Geese (*Plectropterus gambensis*) from S. Africa, four Galapagan Tortoises (*Testudo elephantopus*) from the Galapagos Islands, deposited; a Humboldt's Lagothrix (*Lagothrix humboldti*), an Ocelot (*Felis pardalis*), a Tayra (*Galictis barbara*) from S. America; a Great Barbet (*Megalania virens*), from the Himalayas, purchased.

LOAN COLLECTION OF SCIENTIFIC APPARATUS

SECTION—MECHANICS

PRIME MOVERS¹

HAVING thus mentioned the earliest record of hydraulic (or indeed of any) prime movers I will not endeavour to trace their history down to modern times, as it would be impossible to do so usefully within the limits of an address. I will therefore now ask you to join me in considering what are the conditions which govern the application of water to hydraulic prime movers.

After all water must be looked upon as a convenient form of descending weight. When the fall is not great it is always practicable by means of water-wheels having buckets which retain the water to employ, as I have said, its mere gravity, and probably it is by this mode that the highest result is procured from any given quantity of water falling through a given height. By the use of a backshot wheel as much as 75 per cent. of the total power is obtainable. The 25 per cent. of loss arises from the friction of the axle of the wheel and of the gearing transmitting the force to the machine which is to utilise it, from some of the

water being discharged out of the buckets before the bottom of the fall is reached, from the necessary clearance between the wheel and the tail water, from the eddies produced in the water as it enters the buckets, and (to a certain small extent) from the resistance of the air.

When the difference of level between the source of water and its delivery exceeds, however, 40 or 50 feet, the water-wheel becomes so unwieldy and expensive and revolves so slowly that it ceases to be a desirable prime mover; recourse can then be had to water-pressure engines, engines wherein pistons move in cylinders and being pressed alternately in opposite directions by the head of water set up rotary motion in the machine in the same way as if the pistons were acted upon by steam. In the construction of such water-engines great care must be taken to have ample inlets and outlets in order that the loss incurred either by the power requisite to drive the water through restricted orifices, or by surface resistance caused by a too speedy flow along the various passages may be a minimum. Care has to be taken also in the arrangements of the valves that the engines, when employed for rotary movement, may be able to turn their centres without producing an injurious pressure upon the water within the cylinders. Water-engines employed for pumping, but without rotatory movement, are mentioned by Belidor in his "Architecture Hydraulique," published in 1739, article 1, 156. In England Sir William Armstrong has brought these machines to great perfection. The first of these, erected many years ago, is still working most successfully at the Allan Head Lead Mines. This machine is driven by a natural head of water and not from an accumulator, and is employed in the mine as a winding engine.

An extremely useful feature in engines of this kind is their adaptability to be driven by the pressure of water derived from an ordinary water-works, and in this manner small manufacturers carrying on business in their own houses are enabled to obtain a prime mover with great ease, and, all things considered, at small cost. Not only is advantage taken of such machines for the purpose of driving manufactories, but water cylinders are now largely employed for working the bellows of church organs, for which purpose an overshot water-wheel is shown as being employed as far back as Solomon de Caus's book, date 1615.

Large water-wheels, or even water-engines, are comparatively costly machines, and as large water-wheels make but few revolutions per minute, they require, as has been said, expensive and heavy gearing to get up speed; thus it is that it frequently becomes a desirable thing to dispense with such machines and to resort to other modes of making available high falls of water. In former times this was done by suffering the impetuous stream of water to beat upon the pallets of water-wheels, but from such machines only a poor effect could be obtained, as a large portion of the energy in the water was devoted to the formation of eddies and the generation of heat, and to the production of lateral currents, leaving but a small percentage available as motive power.

Much of the evil effect, however, attendant upon using the impact of water as a means of driving water-wheels is obviated by the construction invented by the distinguished French engineer Poncelet. For high falls, however, the implement now generally employed is the turbine, of which the well-known Barker's mill may be looked upon as the germ.

I have got before me No. 1,983, a model of Fourneyron's turbine.

This is not an apt model for my present purposes, inasmuch as it is one to be employed with a comparatively low fall of water, but even in such instances the turbine gives most excellent results, and it has the advantage over the water-wheel of being able to work with great efficiency although there may be a considerable rise in the "tail water," a rise which would materially check the action of an ordinary water-wheel. In this turbine every care has been bestowed to give a proper form to the pallets on which the water acts so as to take up step by step as it were the whole of the energy residing in the stream, so that the water may pass away from the turbine in an inert condition, and so that in acting upon the vanes of the turbine, eddies may not be formed and thus energy may not be wasted.

There are probably few sights more surprising to the old-fashioned mechanic, who has been used to see water-wheels of 50 or even 70 feet diameter employed for the utilisation of a high fall, than that of a turbine occupying only a few cubic feet of space but running at such a velocity as to consume the whole of the water of a considerable stream, and so to consume it as to deliver nearly as large a percentage of useful effect as would the cumbersome water-wheel itself.

¹ Address delivered by F. I. Bramwell, C.E., F.R.S., one of the vice-presidents of the Section, May 25. Continued from p. 141.